



A web-based self-testing system with some features of Web 2.0: Design and primary implementation

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ABSTRACT

Self-testing is a means to check learning effect. Besides time–space restriction, there are many deficiencies in traditional offline self-testing. With the development of information technology, learners can have self-testing on the Internet. Self-testing on Internet, namely, web-based self-testing, overcomes time–space limitation of traditional offline self-testing, but there are still several disadvantages such as monotony and lack of interaction. In the article, a web-based self-testing system with some features of Web 2.0 is designed and implemented, aiming at overcoming the weaknesses of current online self-testing system. Firstly, taking English self-testing as an example, the framework of the system and functions of its main modules is designed according to theories of social learning and constructivism as well as the idea of Web 2.0 and the characteristics of server-side programming. Secondly, in accordance with the design above, a new system is implemented for English learners primarily by using HTML, JavaScript, PHP, and MySQL comprehensively. The role and duty of webmaster are also described briefly. To test the system, some English learners were invited randomly to use it, and feedback information was collected from them after a period of time. It is shown by feedbacks that most learners are satisfied with the system, and the system is of distinct features and favorable practicality compared with other systems, but it still needs to be improved in the design of user interface and some other details. Results in the article demonstrate that the new system can overcome the shortcomings of current systems to some extent.

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1. Introduction

As we all know, self-testing is an effective means to evaluate one's mastering of knowledge. Experiences indicate that, self-testing, especially those simulated tests before a real one, is very helpful to learners in doing well in the near future. The process of traditional way of self-testing includes preparing test papers, having a test at certain time and place, comparing personal answers with the reference ones, analyzing the results and proposing improvement measures or points for attention. Although it is helpful, there still remain many shortages in traditional offline self-testing besides time–space limitation. First of all, it is of low efficiency. The whole process including preparing, testing, comparing answers and analyzing results needs usually at least half a day or more. In the second place, on most occasions, there is only the learner himself/herself in the whole process. This is very dull, and can often make people feel bored and tired. Thirdly, because of the limitation of one's experience and knowledge, a learner cannot understand the meaning or principle of a question all by himself/herself even if he/she has gotten the reference answer. He/she also needs help and guidance from other people.

With the popularization and use of network, more and more people begin to choose online learning, which has huge advantages compared with the traditional offline learning. As a subset of distance education, it facilitates the learning process via the Internet, and sets the learner free from the restriction that he/she has to be in a classroom (Song, 2007). It also breaks the limitation of time and space, and learners can acquire knowledge at any time and any place (with network connection) they like (Anderson, 2008).

In various applications of online learning, the web-based self-testing is a common one, having many features and advantages of online learning. Learners can answer questions online, and get their scores and helpful suggestions automatically in a few seconds (<http://>

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www.koolearn.com/eclass/qypx/testonline.jsp (Last visited 15.07.09), <http://super.yeshj.com/jp/> (Last visited 15.07.09), <http://www.onlinelearning.net/ole/holwselfassess.html?s=325.g090e694v.0155401e10> (Last visited 15.07.09), <http://www.acg.gi.org/satest/index.asp> (Last visited 15.07.09)). Compared with the traditional offline self-testing, current online self-testing is relatively more efficient and convenient (Lockyer, Patterson, & Harper, 2001; Shapley, 2000; Testsysteme, 2007). There is evidence that frequent users of web-based practice quizzes perform better in final exams (Huon, Spehar, Adam, & Rifkin, 2007). But in fact, it is in essence only a simple simulation of the process of traditional offline self-testing, and what it brings us is only the improvement of efficiency and convenience. It is still tedious and lacking in interaction. The processes of the two types of self-testing are shown in Figs. 1 and 2: the traditional one and the current web-based one.

Oliver and Omari's study (2001) showed that students preferred to use web-based learning to communicate with group members and to solve problems. Through a comparison between paper-based and web-based learning, Lockyer et al. (2001) found that web-based learning has the opportunity to keep a record of discussion. This shows, interaction and discussion with other learners is the distinct feature and advantage of web-based learning. But neither the traditional self-testing nor the current web-based one is satisfactory. The purpose of the study is to design and implement a web-based self-testing system with some features of Web 2.0. It is an open and interactive system having all the functions of current web-based self-testing system, on which basis, it takes full advantage of the characteristic of the Internet: linking people with similar interest together (Jordan, 1999) and utilizing their power. It has a mechanism that can provide technical support for learners to realize and strengthen communication, collaboration and interaction between them, which will overcome the shortcomings of traditional offline self-testing and current web-based one mentioned in paragraphs 1 and 3 in Section 1.

2. Theoretical and practical basis

2.1. Social learning theory

Focusing on the learning that occurs within a social context, the social learning theory, also called social cognitive theory (Irwin, Victor, & Marshall, 1988), has become perhaps the most influential theory of learning and development.

Among others Albert Bandura is considered the leading proponent of this theory. While rooted in many of the basic concepts of traditional learning theory, Bandura believed that direct reinforcement could not account for all types of learning (Bandura, 1977). His theory added a social element, arguing that people can learn new information and behaviors by watching other people, which is known as the observational learning (or modeling) (<http://psychology.about.com/od/developmentalpsychology/a/sociallearning.htm> (Wagner K.V. Social learning theory. Last visited 15.07.09)).

2.2. Constructivism

As an epistemological and philosophic theory, constructivism first appeared in 1980s and caused a great revolution in education and psychology. It emphasizes the relativity of truth, appreciates learners' initiative in learning, and encourages learners to conduct meaningful construction when they are facing different circumstances (Brooks & Brooks, 1993). Jean Piaget's theory of cognitive development, Lev Vygotsky's cultural-historical theory, and some other theories have great influence on the formation and development of constructivism.

Piaget is an influential psychologist in the domain of cognitive development as well as the founder of genetic epistemology. His constructivism is based on his study on the psychological development of children (Kamii & Ewing, 1996). Piaget's constructivism describes the course of constant reconstruction of personal understanding and knowledge through constant summarization of personal experiences. The theory of constructivism focuses on individual; meanwhile it does not reject the importance of social interaction. It believes that learners should interact with the environments they live in, and contact with phenomena which are different from their existing knowledge. The process is realized by the exchange of languages or thoughts (Maypole & Davies, 2001).

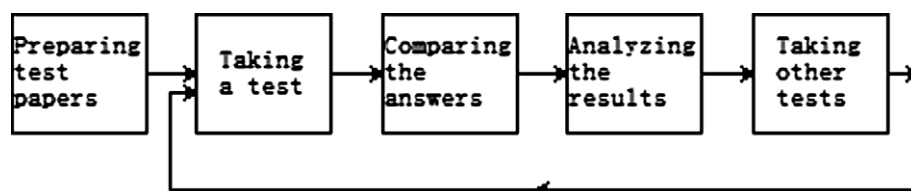


Fig. 1. Process of traditional offline self-testing.

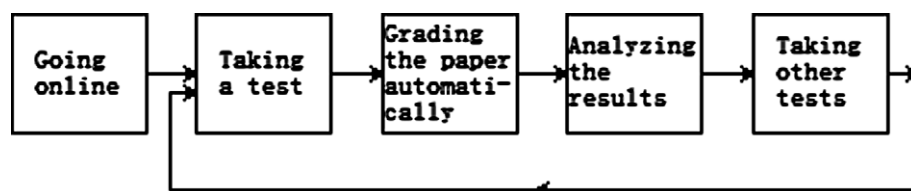


Fig. 2. Process of current web-based self-testing.

2.3. The emergence and development of Web 2.0

The term “Web 2.0” was first used by Dale Dougherty and Craig Cline, and shortly became well-known after the O'Reilly Media Web 2.0 Conference in 2004. Although the term suggests a new version of the World Wide Web, it does not refer to an update to any technical specifications, but rather to change in the ways the software developers and end-users utilize the web. Web 2.0 describes the changing trend in the use of World Wide Web technology and the web design aiming to enhance creativity, communication, information sharing, collaboration and functionality of the web (http://en.wikipedia.org/wiki/Web_2.0 (Last visited 15.07.09)).

Web 2.0 is changing the Internet. Mason and Rennie (2007) pointed out that websites were moving away from isolated information silos to sources of organized contents with much developed links of information on the sites. Users are less passive receivers of information but more active co-creators of contents. McGee and Begg (2008) defined Web 2.0 as a collection of web-based technologies which share a user-focused approach to design and functionality, where users actively participate in content creation and edit through open collaboration between members of communities of practice. The participatory, collaborative, and dynamic online approach of Web 2.0 is what the most serious efforts at web-based development are made for. Where Web 1.0 was mostly a medium for reading, Web 2.0 provides much more opportunities for reading and writing (Rogers, Liddle, Chan, Doxey, & Isom, 2007).

The growth of social networking is another web phenomenon in recent years, which has always supported some forms of social interaction. They emphasized that what has changed with Web 2.0 is the popularity of social networking sites which have three defining characteristics: profile (an identifiable handle and information about a person), traversable (publicly articulated social network), and semi-persistent public comment (participants can leave comments on other profiles for everyone to see) (Mason & Rennie, 2007).

3. System design – taking English self-testing as an example

The system extends the function of traditional online self-testing system, incorporated with the online interactive collaboration and communication functions, combining the two types of function organically. After user logging in the system, users cannot only perform self-test, but also interact, collaborate and communicate with other learners, so that learning process becomes more interesting and efficient (Kim, 2008; Saade & Bahli, 2005). Here, we take English test as an example to complete the design of the system.

3.1. English learning in China

As an international language, English is popular in China over these years. Chinese people, especially students, have been always attaching great importance to the learning of English (Xu, 2005). As a communicative tool, English is necessary for an open and modern country. For China's entry to the world arena and the world's better understanding on China, the function and status of English is self-evident. Therefore in many kinds of examinations in China, such as entrance examination, professional examination and qualification examination, English is almost an absolutely necessary part. Most of the domestic English examination papers adopt the structure comprised of subjective part and objective part; the former usually includes translation, short answer, writing, etc., while the latter always covers various choice questions with single choice or multiple choices, generally including listening comprehension, grammar, vocabulary, reading comprehension, etc.

3.2. Overall structure of the system

The system adopts three-tier structure based on Browser/Server (B/S) model. Three-tier B/S structure is formed by adding Web and application servers into conventional two-tier Client/Server (C/S) structure model. As shown in the Fig. 3, three-tier structure means: client, middle tier application and back-end database.

Client, the first tier, served by web browser, is the interface for the users to interact with the system. This layer uses a computer connected to the Internet, allowing users to enter a user name and password to login, to carry out various online operations and receive the user's HTTP requests to submit to the web server.

Middle tier application, the second tier, which is the core of the entire system, acts as a bridge and a link, constituted by web server and application server. Web server processes user's HTTP request, and organizes processing results at the background into HTML pages, sending to the user's browser to display. Application server is used for storing function modules and applications of the system, using these modules and applications to deal with the requests from clients, meanwhile accessing back-end database server, and then after series of activities like queries, delete, update and insert, the corresponding processing results are feed back to the clients through web server. All major functions of our system (self-testing, interaction, communication, etc.) are implemented in this tier.

Back-end database, the third tier, refers to the database, which provides data services and manages all the data. The main databases used in our system are examination database, user database, posts database and message database.

3.3. System framework design

In order to use the system, the learner should register as a member at the first time when they visit the site. Later on they can log in the system using a unique username and corresponding password. Unregistered users cannot use most of the functions in the system, which mainly consists of three parts: self-testing module, interaction module, collaboration and communication, and supporting module.

There is a back-end paper database in the self-testing module. Different test papers may have different structures and thus have different background programs and algorithms. When a learner finishes a test and submit the paper, the system will automatically grade and analyze the answers. Besides, it will propose relevant constructive counter measures and suggestions for the learner, so that the learner can improve or adjust his/her study according to the helpful advice. A test paper usually consists of subjective part and objective part, in which the subjective contents, such as writing or translation, cannot be graded and analyzed automatically by the computer program

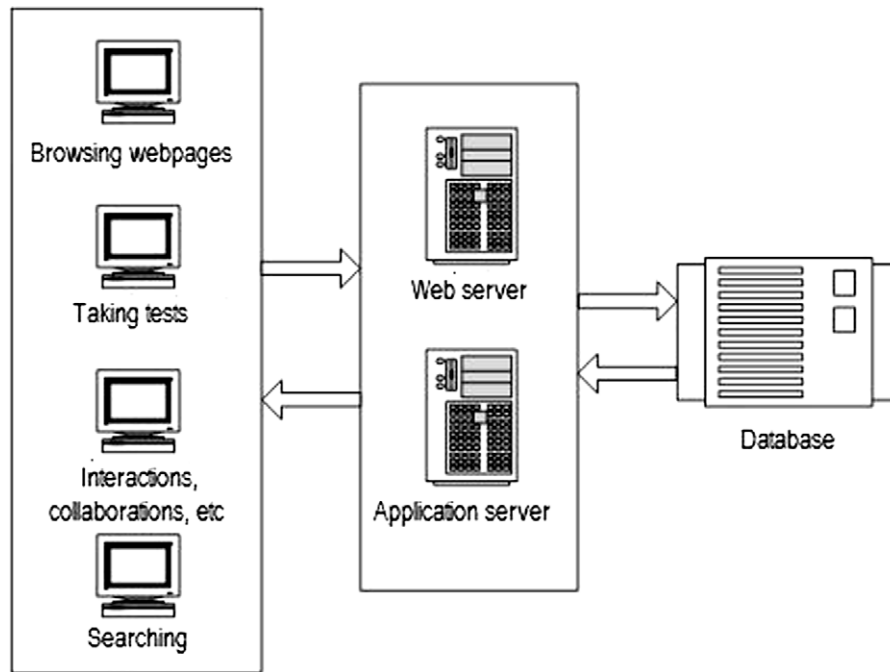


Fig. 3. Web-based three-tier system structure.

at present; as a result, the strategy we take is to evaluate them by manpower of web friends. As to the objective contents in papers, we evaluate them automatically by the computer program.

As an old proverb goes, learning without exchanging views with others makes one poorly informed and ignorant. The system takes full advantage of the network, brings the interaction mechanism of virtual social community into self-testing system, and broadens the social network between learners (Greenhow & Belbas, 2007). In the interaction, collaboration and communication module, a registered learner can browse another learner's information freely, and can also send messages to or make friends with other learners. An intimate friendship between learners will develop through a mutual understanding. "Friend" can be anyone who you are interested in or who is congenial to you on the net. "Friend" stands for a closer relationship and makes your online learning more interesting. The supporting module is an assistant and supplement to the former two modules, making the whole system easier to use and more complete. The three modules are not separated entirely but are designed to form an organic whole. There are some intersections of functions between different modules. Fig. 4 shows the process of online self-testing in the new system we have designed.

3.4. Main module design

The system design mainly adopts modular designing method. This system mainly consists of three modules of online test, interactive communication and collaboration, and ancillary support, which form a relatively complete functional system. The functional modules are as shown in Fig. 5.

Self-testing module: We chose test papers from nationwide English tests to design the test paper database. According to the national law, people can use or spread examination papers for the purpose of learning, education or academic research. In this module, learners can look over exam-related information, discuss with each other about the exam, and take tests. When a learner begins to take a test, a timer will be activated simultaneously. When a test is finished and submitted, the system will evaluate and analyze it automatically. For example, if the

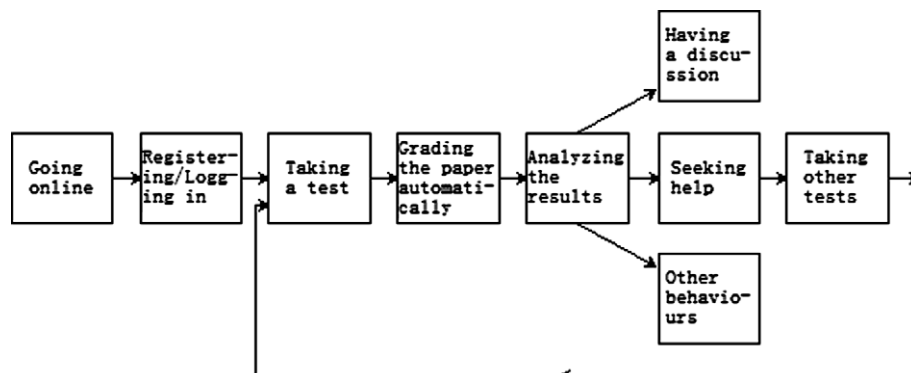


Fig. 4. Web-based self-testing with Web 2.0 features.

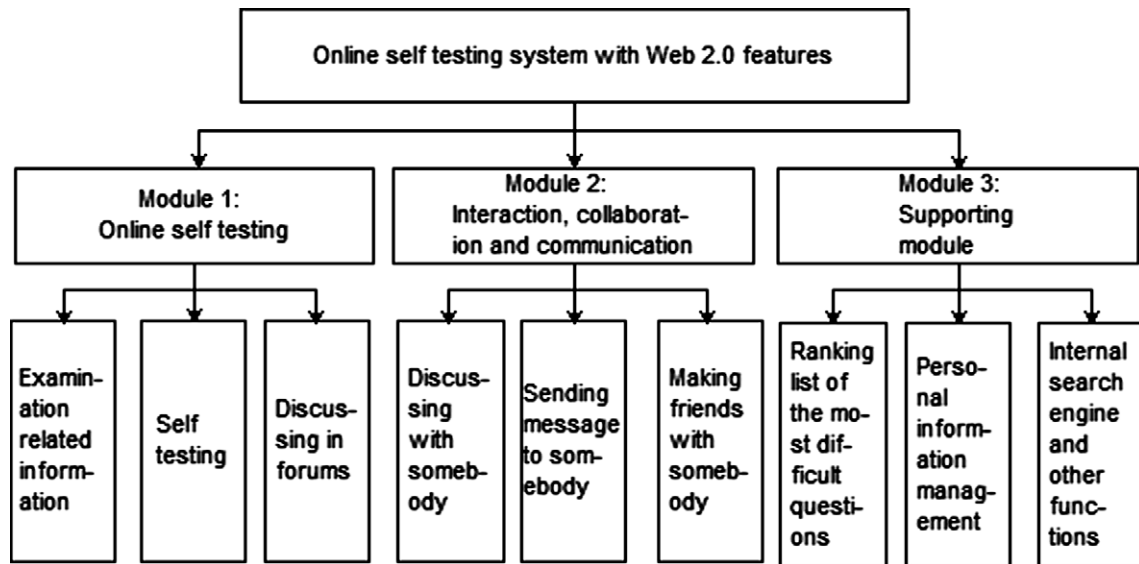


Fig. 5. Module framework.

accuracy rate of listening is lower than 60%, the system will advise the learner to strengthen his/her listening and guide him/her to the page of special trainings and exercises for listening aiming at weak points, and learning from mistakes is a very effective study manner. For the subjective questions, when a learner submits the paper, the answers of subjective part will be post in a discussion area relating to the test the learner has taken, and be commented by zealous web friends on the net. The discussion area is a place where learners can voice any kind of questions or opinions about the test. There is a fixed corresponding discussion area for each test.

Module of interaction, collaboration and communication: This module is designed to strengthen interaction, collaboration and communication between learners (Beldarrain, 2006; Suthers, Vatrappu, Medina, Joseph, & Dwyer, 2008; Weinberger & Fischer, 2006). In the system, all learners are equal, for equality is the foundation for interaction, collaboration and communication between all learners. In order to make the system embody some features of Web 2.0 properly, we designed a mechanism of interaction, collaboration and communication, including: (1) in the discussion area learners can post new threads and give replies on the threads of other people; (2) learners can browse the basic profile information of other people, but to browse the detailed profile information is only permitted between friends; (3) learners can send messages to other people in the system. The topic of message can be about learning or anything else; and (4) learners can make friends with each other. A learner can get to know the learning condition and plan of any of his/her friend and contact with him/her easily.

Supporting module: This module includes the ranking list of the most difficult questions, management of personal information, internal search engine, etc. In the ranking list of the most difficult questions, the system automatically computes and presents the most difficult questions according to test papers submitted by all learners. Under the management of personal information, a registered user can browse and modify his/her personal profile information, and browse threads he/she published, threads he/she participated in, messages he/she received from and to his/her friends. Using the internal search engine, a user can search information or resources in the system in four ways: (1) searching the test paper; (2) searching the thread; (3) searching the special training and exercise; and (4) searching the registered user and information related to him/her.

3.5. Excitation mechanism of the system

Nonnecke, Andrews, and Preece (2006) described the nonpublic participation within an online community and name it as "lurking". It is not favorable for the development of online community that members lurk for a long time (Rafaeli, Ravid, & Soroka, 2004). Since an open network community is of great spontaneity, for most web communities, the excitation mechanisms are essential in order to ensure its smooth operation (Chiu, Hsu, & Wang, 2006; Jeppesen & Frederiksen, 2006). How to avoid network lurking phenomenon? Our method is to classify the users, with different of authority corresponding to different levels. Let those initiating more topics and participating in more topics in the system possess higher level (there is a specific algorithm). The higher level the users are in, the greater authority they will possess, to browse more information or use of more functions. For example, we divide the topics in discussion zone into general content (all registered users can browse) and restricted content (a certain level of users can browse). In this way, the users can be stimulated to improve their levels and arouse their enthusiasm by participating in the interaction. There are also similar approaches like grading down-load resources, exercise resources, etc. in the system.

3.6. Developing environment

The system is based on browser-server technology. On the browser side (client side), we use HTML and JavaScript to display the web pages seen on the browser by learners. HTML, the acronym of Hyper Text Markup Language, is the predominant markup language for web pages, and a computer language devised to allow website creation (Shannon, 2007). It specifies the structure of documents for retrieval across the Internet using browser programs. JavaScript, first designed by Netscape, is a script language widely used in client-side web development.

On the server side, we use PHP to realize dynamic pages and complex functions. PHP, the acronym of Hypertext Preprocessor, is a widely used general-purpose script language that is especially suited for web development and can be embedded into HTML. An advantage is that it can be used in all major operating systems: Windows, Linux, BSD, Macintosh, etc. The most significant feature of PHP is its support for a wide range of databases including MySQL, OCBC, Oracle, Sybase, dBase, etc. (<http://www.php.net> (Last visited 15.07.09)).

Database: we use MySQL to design and generate database for data storage. MySQL is the most popular open source database in the world. It is a RDBMS (relational database management system) based on SQL (Structured Query Language). Because of MySQL's small size, fast speed and especially open source, many small and medium websites choose it as their website databases to reduce costs. (<http://www.mysql.com/> (Last visited 15.07.2009)).

Both PHP and MySQL can be downloaded from their official websites listed above and used for free.

4. Primary implementation

In this section, we will illustrate problems of the system in implementing several main functions, based on the design of the English self-testing system above.

4.1. Implementation of online testing and automatic assessment

Fig. 6 is part of the interface of taking a test in the system. After users complete and submit the test, the system will compare the answers of the objective part in the user's paper with the reference answers in the database, and calculate the scores of the users according to the scoring rules. The subjective part in the paper will be automatically inserted in the discussion area, to be judged by netizens. The reference answers are given in the test results part of the system, with the user's detail scores of objective part listed, and suggestions are given according to the scores. In the assessment result shown in Fig. 7 the system shows that the result of the tester is ordinary, and he or she needs to strengthen the knowledge in the "close test" and "reading comprehension" and do more exercises. Then the system will further guide the learners into study and tests aiming at those knowledge. If learners have different opinion on the standard answer, he or she may question the subject.

4.2. Most difficult and doubtful subjects

The system will automatically counts and records the wrong frequency of each subject in the papers according to the test results of all the learners, and sort the wrong subjects in accordance with the wrong frequency from high to low. Generally, the higher the wrong frequency of the topic, the more difficult the topic will be, and thus we can assume that, sorting the subjects in accordance with the wrong frequency is to sort them according to difficult level.

As mentioned above, when viewing the test results, the tester may question the standard answer. Because even though the standard answers of the subject in the papers are generally correct, in few cases, some of the standard answers will also be an error, ambiguity, or need to be further discussed. The system will automatically record and count the questioning frequency of the standard answer for every subject the questions by the testers, and sort by descending order according to the frequency (see Fig. 8). Top-ranking subjects tend to be the relatively more controversial ones. We can understand and master more knowledge by discussing the subjects (McNamara & Brown, 2009).



Fig. 6. Screenshot: taking a test.

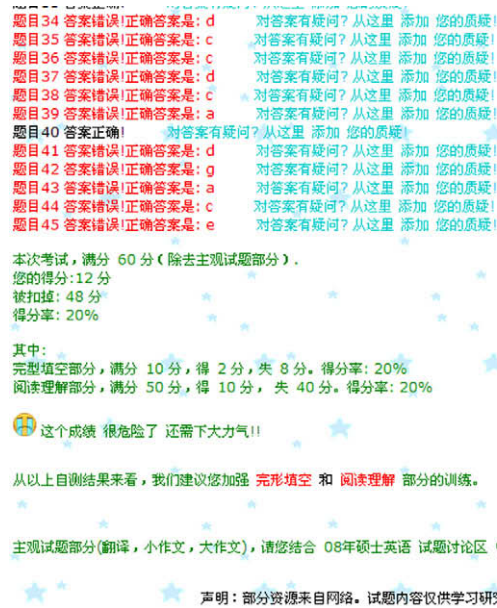


Fig. 7. Automatic assessment.



Fig. 8. Most difficult subjects.

4.3. Implementation of discussion

The function of discussion is similar to that of online forum or BBS. User in a discussion zone can browse other learners' topics, participating in a topic, or raise a new topic. The process of discussion is a course of interaction and communication. In the process, various viewpoints and ideas rush and dash and thus consensus forms gradually. Fig. 9 shows the list of topics in a discussion zone and Fig. 10 is the screenshots of initiating a new topic.

4.4. Implementation of send message to and making friends with others

This function is mainly implemented in the discussion area. In discussion area, the initiator and publishing time are shown after each topic. When you browse the topics of other learners in discussion zone, if you find a very interesting topic and want to know more about the initiator, you can enter his or her personal information interface by clicking the user name of initiator of the topic. In personal information interface, information includes time when he or she registered, the topics he or she has initiated, the topics he or she has



Fig. 9. Discussion area.

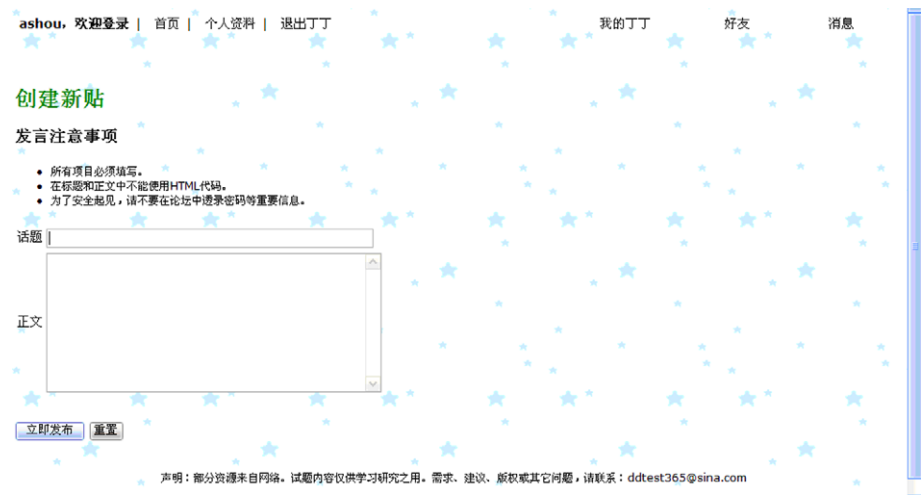


Fig. 10. Initiating a new topic.

participated in, examinations he or she has taken, etc. This interface includes two important buttons which are “send a message” and “add to friends (as shown in Fig. 11). Click the button “send a message”, you will enter the interface for sending him or her message, to write a message and send to him or her. This function is a tool for communication between registered users, and the information can only be seen by the senders and the receivers. Users can maintain their private contacts with other users within the system by this function. In addition, by clicking “add to friends”, you can add him or her to your friends list, allowing you to know his or her news in the first time. Friends are the people group of people in this virtual community, who have relatively close relationship with you.

4.5. Management and maintenance

For most websites, the work of management and maintenance is just started after its implementation. We call the person in charge of such work webmaster. The role of webmaster is crucial for the normal development and operation of a website. Simply speaking, maintaining a website means keeping everything working regularly, that is, if there is a broken link, fix it; if there is spam from other sites, work on it; if there are trouble makers posting nonsense on the forum, ban them (Chow, 2008). The work of system manager also includes database maintenance, users management, topics (posts management), etc. Besides, although this is an open system without specific instructors, but necessary leadership is indispensable (Garrison & Cleveland-I, 2005). So, other work of a webmaster includes organizing, guiding and coordinating online behaviors and relationships between different users (Zmijewski, 2003) and recruit moderator of each discussion zone.



Fig. 11. Sending message and adding to friends.

5. Results and discussion

In order to examine the system, after the primary implementation, we invited some learners randomly to use it and comment on it. We have received many e-mails from users through the mail box of this site and here are some typical comments on the system from these learners:

"The system is highly automated. For a person who is going to take an examination, it is very good. To my surprise you have realized functions of social communication! Although it is slightly simple compared with some commercial SNS (Social Networking Service) websites, it really very useful. By the way, the information on the site is not sufficient, and I suggest you add information like reading materials, examination news and funny English videos in the future development."

"The idea of this system is very interesting. The web pages are concise but handsome. Generally it is easy for a newcomer to use the system correctly, but in the part of communication and interaction, the design of your user interface is not thoughtful enough — it took me some minutes to find how to communicate with other people. To improve it, you may add some directions for use in proper position in the page. "

"Compared with some frequently used online self-testing systems at present, this system has its distinguishing features. The idea is not complicate but very ingenious and practical. I hope you can finish developing it as soon as possible."

From the feedbacks of learners, we can find they are basically satisfied with the design and implementation of the system. But the user interface of system needs to be improved indeed. We deeply understand that the user interface is very important for the success of a system. At the phase of system design, the feelings and habits of users should be taken as a premise: the function we design should be usable and friendly.

In order to examine the efficiency of the system further, we carried out a web-based questionnaire survey to know their evaluation and level of satisfaction to the system functionality (Huang & Yang, 2009). The questionnaire included five questions which related to the performance of the system and users' feelings, etc. (Appendix A). There were 85 people in total who participated in the web-based questionnaire survey, wherein effective questionnaires were 81 (excluding the empty and incomplete questionnaires), and the effective rate was 95%. After the questionnaires were collected, we used SPSS 14.0 software to count and analyzed the questionnaire results.

In the questionnaire, each item used the 5-point Likert scale and the score ranged from 1 to 5. Higher scores indicate more positive responses. Table 1 shows that students thought that it is important to support interaction, collaboration and communication in self-testing system. They agreed that this system is able to support online interaction, collaboration and communication between the learners. They agreed that interaction, collaboration and communication can support their online self-testing. Compared to other online self-testing system, they agreed that new system is more efficient and interesting. Over all, they are satisfied with the new system.

Table 1
Testers' perception with the system.

Question	Mean	SD	Component	
			1	2
Do think it is important to support interaction, collaboration and communication between different learners in a self-testing system?	4.432	0.498	−0.039	0.940
Do you agree that interaction, collaboration and communication can support your online self-testing?	4.062	0.639	0.517	0.595
Do you agree this system is able to support online interaction, collaboration and communication between the learners?	4.037	0.641	0.799	−0.023
Compared to other online self-testing system, do you agree that our system is more efficient and interesting?	4.111	0.477	0.805	0.075
Over all, are you satisfied with the system?	4.210	0.518	0.779	0.243

Factor analysis shows that these questions have two main components. Table 1 shows the factor loadings for questions on these two components. Questions 1 and 2 are used to measure the subjective feelings of users of the system. Questions 3–5 are used to measure system performance and satisfaction. Therefore, this questionnaire has good construct validity. Since the Cronbach's alpha value is 0.706 and higher than 0.7, this questionnaire also has good reliability.

The system operation condition and statistical data analysis shows that we have basically achieved the purpose set in the Introduction section.

Although the technologies used in the system are not too sophisticated or complex, we combine two common Internet information technologies together, based on the educational theories of constructivism and combining the development trend of the present internet, and apply these to the practice of education and learning. This is the prominent feature of the system.

Since it is an initial implementation, the system still has many deficiencies. At present, we have only developed main functions, and the detail we do is still not very well. In our next step, we will improve the system further in the following aspects: improving the system function and design to make it more intelligent and friendly to use, increasing the quantity of test papers in the database, and developing online resources and materials relating to learning. We have to further improve the quality of interactive collaboration and communication between learners, and research and develop some more interesting and practical functions (Tallent-Runnels, Thomas, Lan, & Cooper, 2006).

6. Conclusion

It is shown by practices and feedbacks that the self-testing system with some features of Web 2.0 is feasible and welcomed. Firstly, it is at high level of automation and efficiency. Secondly, it collects wisdom from different learners and makes problem solved more easily and correctly. And thirdly, this system is also featured by various kinds of communications and interactions between different learners, making the online self-testing dynamic and interesting. This study once again illustrates the great attractiveness of web-based interactive, collaborative learning method.

This article take English self-test as an example to illustrate the design and implementation of the online self-test system with the features of Web 2.0. With respect to the application, the system is of good universality. Besides English self-testing, the design idea and implementation method can be applied to other subjects easily.

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Appendix A. Questionnaire

1. Do you think it is important to support interaction, collaboration and communication between different learners in a self-testing system?
Very unimportant |☐|☐|☐|☐| Very important.
2. Do you agree that interaction, collaboration and communication can support your online self-testing?
Very disagree |☐|☐|☐|☐| Very agree.
3. Do you agree this system is able to support online interaction, collaboration and communication between the learners?
Very disagree |☐|☐|☐|☐| Very agree.
4. Compared to other online self-testing system, do you agree that our system is more efficient and interesting?
Very disagree |☐|☐|☐|☐| Very agree.
5. Over all, are you satisfied with the system?
Very unsatisfied |☐|☐|☐|☐| Very satisfied.

References

- Anderson, T. (2008). *The theory and practice of online learning*. Alberta: Athabasca University Press.
- Bandura, A. (1977). *Social learning theory*. Orrville Ohio: Prentice Hall.
- Beldarrain, Y. (2006). Distance education trends: integrating new technologies to foster student interaction and collaboration. *Distance Education*, 27(2), 139–153.
- Brooks, J., & Brooks, M. (1993). *In search of understanding: The case for constructivist classrooms*. Alexandria (VA): Association for Supervision & Curriculum Deve (ASCD).
- Chiu, C. M., Hsu, M. H., & Wang, E. T. G. (2006). Understanding knowledge sharing in virtual communities: an integration of social capital and social cognitive theories. *Decision Support Systems*, 42(3), 1872–1888.
- Chow, D. W. (2008). *The role of a webmaster in your internet business*. <<http://ezinearticles.com/?The-Role-of-a-Webmaster-in-Your-Internet-Business&id=1825584>>. Last visited 15.07.2009.
- Garrison, D. R., & Cleveland-I, M. (2005). Facilitating cognitive presence in online learning: Interaction is not enough. *The American Journal of Distance Education*, 19(3), 133–148.
- Greenhow, C., & Belbas, B. (2007). Using activity-oriented design methods to study collaborative knowledge-building in e-learning courses within higher education. *International Journal of Computer-Supported Collaborative Learning*, 2(4), 1556–1607.
- Huang, S.-L., & Yang, C.-W. (2009). Designing a semantic bliki system to support different types of knowledge and adaptive learning. *Computers & Education*, 53(2009), 701–712.
- Huon, G., Spehar, B., Adam, P., & Rifkin, W. (2007). Resource use and academic performance among first year psychology students. *Higher Education*, 53, 1–27.
- Irwin, M., Victor, J., & Marshall, H. (1988). Social learning theory and the health belief model. *Health Education & Behavior*, 15(2), 175–183.
- Jeppesen, L. B., & Frederiksen, L. (2006). Why do users contribute to firm-hosted user communities? The case of computer-controlled music instruments. *Organization Science*, 17(1), 45–63.
- Jordan, T. (1999). *Cyberpower: The culture and politics of cyberspace and the Internet*. New York: Routledge.

- Kamii, C., & Ewing, J. K. (1996). Basing teaching on Piaget's constructivism. *Childhood Education*, 72(5), 260–264.
- Kim, C. M. (2008). Using email to enable e³ (effective, efficient, and engaging) learning. *Distance Education*, 29(2), 187–198.
- Lockyer, L., Patterson, J., & Harper, B. (2001). ICT in higher education: Evaluating outcomes for health education. *Journal of Computer Assisted Learning*, 17, 275–283.
- Mason, R., & Rennie, F. (2007). Using Web 2.0 for learning in the community. *The Internet and Higher Education*, 10(3), 196–203.
- Maypole, J., & Davies, T. G. (2001). Students' perceptions of constructivist learning in a community college American history survey course. *Community College Review*, 29(2), 54–79.
- McGee, J. B., & Begg, M. (2008). What medical educators need to know about "Web 2.0". *Medical Teacher*, 30(2), 164–169.
- McNamara, J., & Brown, C. (2009). Assessment of online discussion in work-integrated learning. *Campus-Wide Information Systems*, 26(5), 413–423.
- Nonnecke, B., Andrews, D., & Preece, J. (2006). Non-public and public online community participation: Needs, attitudes and behavior. *Electronic Commerce Research*, 6(1), 7–20.
- Oliver, R., & Omari, A. (2001). Student responses to collaborating and learning in a web-based environment. *Journal of Computer Assisted Learning*, 17, 34–47.
- Rafaeli, S., Ravid, G., & Soroka, V. (2004). De-lurking in virtual communities: A social communication network approach to measuring the effects of social and cultural capital. In *Proceedings of the 37th Annual Hawaii International Conference on System Science (HICSS' 04) – Track 7 (Vol. 7, pp. 70.203)*.
- Rogers, P. C., Liddle, S. W., Chan, P., Doxey, A., & Isom, B. (2007). Web 2.0 learning platform: Harnessing collective intelligence. *Turkish Online Journal of Distance Education* 8(3), 16–33. <http://tojde.anadolu.edu.tr/tojde27/articles/article_1.htm>. Last visited 15.07.09.
- Saade, R., & Bahli, B. (2005). The impact of cognitive absorption on perceived usefulness and perceived ease of use in on-line learning: An extension of the technology acceptance model. *Information & Management*, 42, 317–327.
- Shannon, R. (2007). What is HTML? <<http://www.yourhtmlsource.com/starthere/whatishtml.html>>. Last visited 15.07.09.
- Shapley, P. (2000). On-line education to develop complex reasoning skills in organic chemistry. Online Education. In *Proceedings of the Sloan summer workshop on asynchronous learning networks*. pp. 41–47.
- Song, H. B. (2007). *Interaction in online learning*. Beijing: Peking University Press.
- Suthers, D. D., Vatrappu, R., Medina, R., Joseph, S., & Dwyer, N. (2008). Beyond threaded discussion: Representational guidance in asynchronous collaborative learning environments. *Computers & Education*, 50(4), 1103–1127.
- Tallent-Runnels, M. K., Thomas, J. A., Lan, W. Y., & Cooper, S. (2006). Teaching courses online: A review of the research. *Review of Educational Research*, 76(1), 93–135.
- Testsysteme, M. (2007). *Online language testing – Conciliating efficiency with validity*, Online Educa Berlin. <<http://www.trainingpressreleases.com/newsstory.asp?NewsID=3360>>. Last visited 15.07.09.
- Weinberger, A., & Fischer, F. (2006). A framework to analyze argumentative knowledge construction in computer-supported collaborative learning. *Computers & Education*, 46(1), 71–95.
- Xu, Y. B. (2005). Analysis on the phenomenon of English craze in China. *Journal of Engineering College of Armed Police Force*, 21(6), 80–81 (in Chinese).
- Zmijewski, B. (2003). "Webmaster"? It's cool again. <<http://www.nmbvi.com/nmbvi/news1.asp>>. Last visited 15.07.09.